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OCEAN WAVE PATTERNS UNDER HURRICANES

While much progress has been made in avoiding the loss of human lives due to hurricanes, primarily because of aircraft and satellite surveillance techniques, the meteorology of this cyclonic heat engine is not yet fully understood. Conventional techniques have not been adequate in acquiring data under hurricanes. However, the airborne Synthetic Aperture Radar (SAR) has been shown by JPL to be very useful in collecting information under hurricanes, particularly of the wave patterns. Since 1976, JPL has been collecting information on the directional properties of hurricane waves using the SAR onboard a NASA CV-990 research aircraft. These include the Tropical Storm Emmy, Hurricane Gloria, Typhoon Heather, and the Hurricane Frances.

The opposite figure shows the typical wave pattern under a hurricane. The figure shows that the waves are not symmetrically distributed around the hurricane eye. Dominant waves propagate ahead of the hurricane along

lines normal to the local wind direction. (The wind-field blows in a counterclockwise spiral around the eye.) Confused and unexplained directional distributions can be seen in the lower right sector of the hurricane. While much of the information in the figure is yet to be explained, some major observations can be stated. The axial symmetry of the wavefield can be attributed to the forward motion of the hurricane. The residence time for wave generation is significantly greater in the region to the right of the eye if the hurricane has a moderate forward velocity. The dominant growth appears to be associated with group velocities that are equal to or somewhat greater than the speed of the hurricane. The dominant waves spread out in an arc ahead of the hurricane eye and have wavelengths of the order of 250 meters with a corresponding group velocity of 10 meters per second. The hurricane forward speed is 8 m/s. These waves appear to have optimum hurricane residence time with respect to wave generation.

Figure (opposite page): Directional spectral wave transformations, Hurricane Gloria, 30 September 1976.

